# Space Weather Technical Forecast

Issued on Sunday, 18 February 2024 at 12:31 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

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**Space Weather Forecast Headline: Chance of isolated M-class flare.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Low solar activity with the peak flare a likely multipart C7.9 at 17/1834UTC, primarily from AR3584 but with likely some contribution from a concurrent flare from AR3576 just over the southwest limb. There are currently five active regions on the visible disc. The main flare risk remains from the significant looping of AR3576 which remains visible over the southwest limb. This risk will continue to recede. AR3583 is the most complex and developmental spot currently on the disc, with little overall change. The other regions on the disc remain smaller and simpler.
No significant Earth-directed CMEs were observed in this period, with a faint filament eruption from the southwest disc at around 17/0219 UTC assessed as both slow and likely passing south of Earth.

**Solar Wind / Geomagnetic Activity:** Solar winds as observed by ACE remain slow-ambient - just below 350 km/s. Density was below average. The Interplanetary Magnetic Field (IMF) Bt, was generally weak at 5-9nT. North-south component of the magnetic field, Bz, was also weak peaking at +6nT but was generally negative (southward) with a minimum of -9nT. Phi was positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0 to 3).

**Energetic Particles / Solar Radiation:** GOES18 high energy (greater than 10MeV) proton flux was just above background levels. Electron flux (greater than 2MeV) has been at background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed fluence at 18/0000UTC was 1.21e6 pfu.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Moderate to Low activity is forecast, with an ongoing but decreasing chance of isolated M-class flares. There remains a slight chance of an X-flare into day 1 (18 Feb), primarily from AR3576 which is now over the southwest limb

**Solar Wind / Geomagnetic Activity:** Recent CMEs are expected to either miss or only have very minimal impact on Earth, with the most likely for an Earth-directed component being the filament eruption from the north-disc on 16 Feb, passing near Earth day 2-3 (late 19 Feb or early 20 Feb). No other significant solar wind enhancements feature in the period with mainly background winds expected. Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming Unsettled with Active intervals with any CME arrival on days 2-3 (19-20 Feb).

**Energetic Particles / Solar Radiation:** GOES18 high energy (greater than 10MeV) proton flux will remain near background with a slight chance of further enhancement if any significant flares occur from either the regions on the western disk, or more likely from AR3576 just over the limb.

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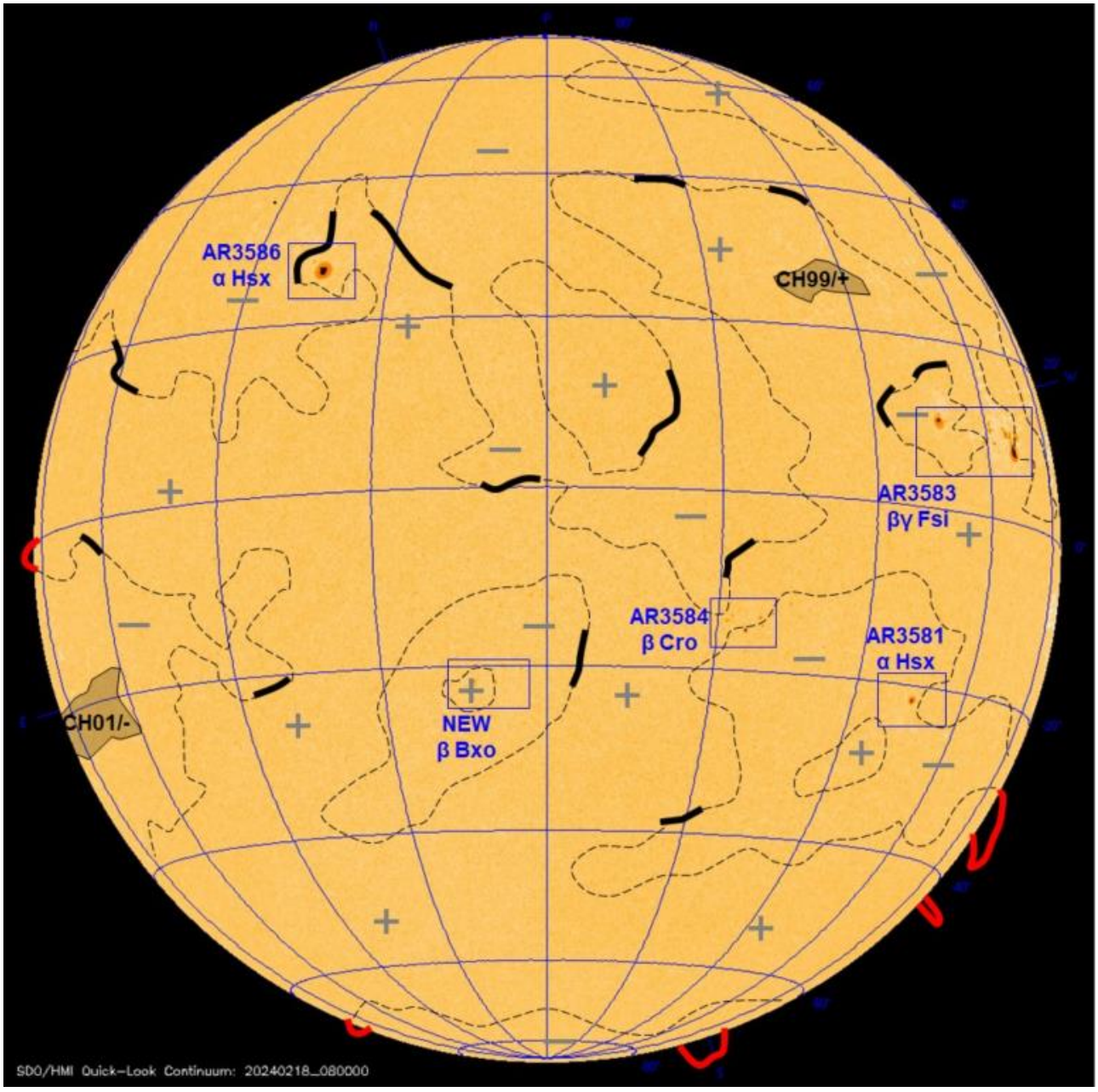
# Met Office Space Weather Technical Forecast

High energy electron flux (greater than 2MeV) is expected to remain at background levels. The associated 24-hour electron fluence is expected to stay below the Active threshold.

**Figure 1. Solar Analysis Valid 0800UTC, 18 February 2024.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

There is one main Earth-directed CME possible. This was a result of a filament eruption from the north centre disk on 16 Feb. The majority of the ejecta is expected to travel north above Earth's orbit, but with the potential for some glancing influence either later day 2 (19 Feb) or early day 3 (20 Feb). The CME in association with the X2.5 flare from AR3576 is expected to pass ahead of and below Earth's orbit, although some peripheral shock enhancement is possible over similar period to the above.

No significant coronal holes are visible on the Earth-facing disc, with just a couple of very small and weak areas seen in imagery. In the absence of any significant CME arrivals, solar wind speeds are expected to remain near ambient or perhaps occasionally slightly elevated levels. Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming Unsettled with a chance of Active intervals and a very slight chance of G1 Minor storm intervals with any CME arrival on days 2-3 (19-20 Feb).

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | No | 1 | 5 | 10 | 1 |
| Strong | G3 | No | 1 | 1 | 1 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

## Geomagnetic Activity - Earthbound Coronal Mass Ejections

| Date/time 21.5R (UTC) | Halo: Full or Partial | Source | Source Location | Estimated Speed | Estimated Arrival Time | Comments |
|---|---|---|---|---|---|---|
| 16/2232 | Partial | Filament eruption | NE | 850 km/s | 19/2000UTC +/- 12hrs | Glancing impact most likely |

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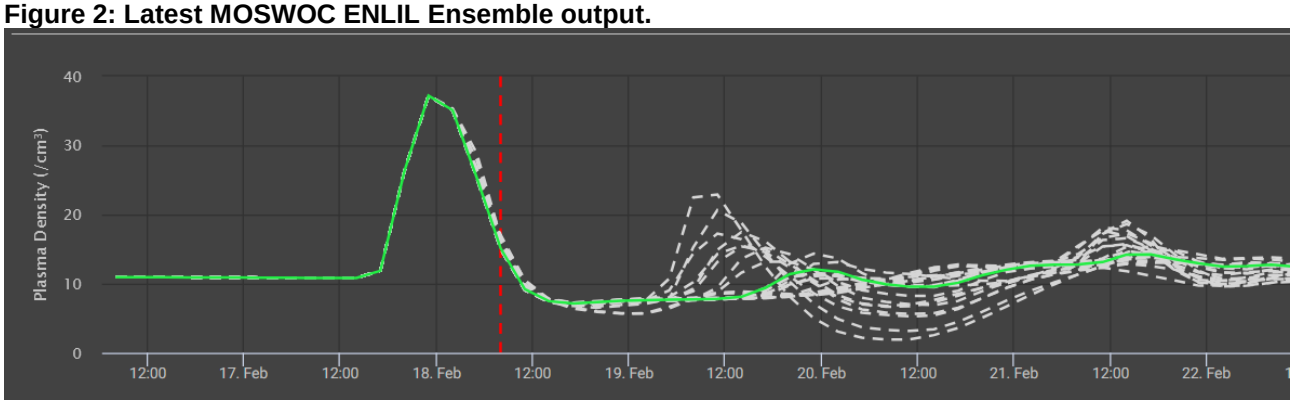
**Figure 2: Latest MOSWOC ENLIL Ensemble output.**




## Radio Blackouts - X-Ray Flares:

Moderate to Low solar activity is forecast, with an ongoing chance of an isolated M-class flare. There remains a slight chance of an X-class flare on day 1 (18 Feb), primarily from AR3576 which is now over the southwest limb, however this risk recedes by day 2 (18 Feb) onward with the other regions currently on the visible disc smaller and exhibiting less complexity.
Ex-AR3576 likely remains a large, magnetically complex sunspot region, with some significant looping still visible on e.g. SDO aia-171 and 304, and any notable flares have the potential to still be visible on the Earth-facing disc, particularly during day 1 (18 Feb). Of the five sunspot regions currently on the Earth-facing disc AR3583 in the northwest is the most complex and main source of significant flaring. Ex-AR3575 transiting across the far side of the disk is anticipated to be crossing the southeast limb at the end of this guidance period. This region is probably the source of multiple large far-side CMEs over previous days.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 50 | 30 | 20 | 30 |
| Very Active | R3 to R5 X Class | No | 10 | 5 | 1 | 1 |

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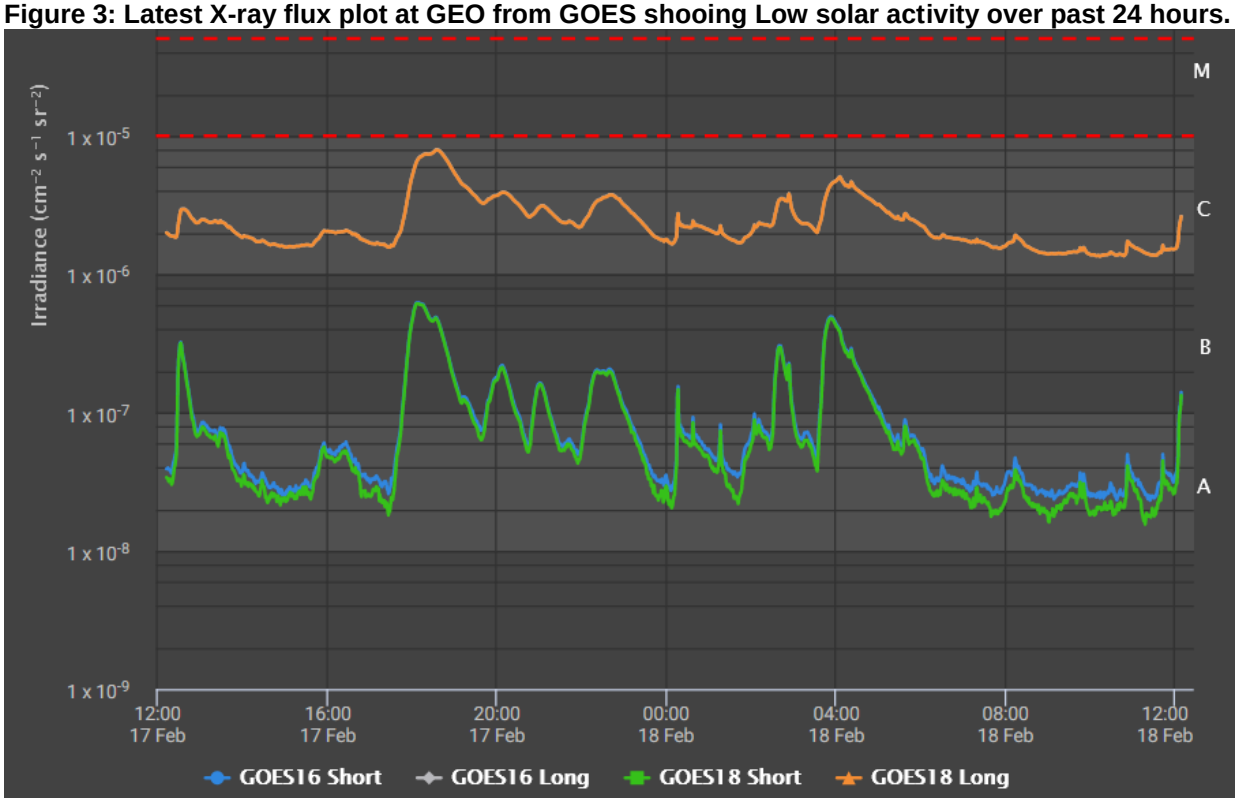
**Figure 3: Latest X-ray flux plot at GEO from GOES shooing Low solar activity over past 24 hours.**




## Solar Radiation Storms - (High Energy Protons):

GOES 18 high energy (greater than 10MeV) protons have settled close to background levels in the past 24 hours. AR3576 will continue to give a decreasing risk for further proton enhancements as it moves across the far-side. The current regions on the Earth-facing disc have a lower chance of notable flares, and are currently considered unlikely sources of further solar storms.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 15 | 10 | 5 | 1 |
| **Very Active** | **≥ S3 *** | No | 1 | 1 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

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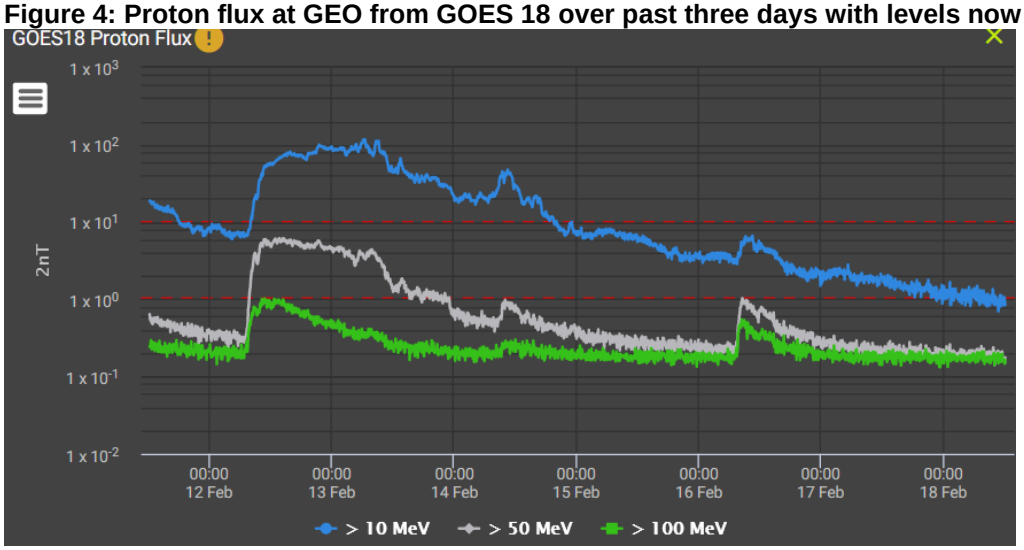
**Figure 4: Proton flux at GEO from GOES 18 over past three days with levels now near background.**



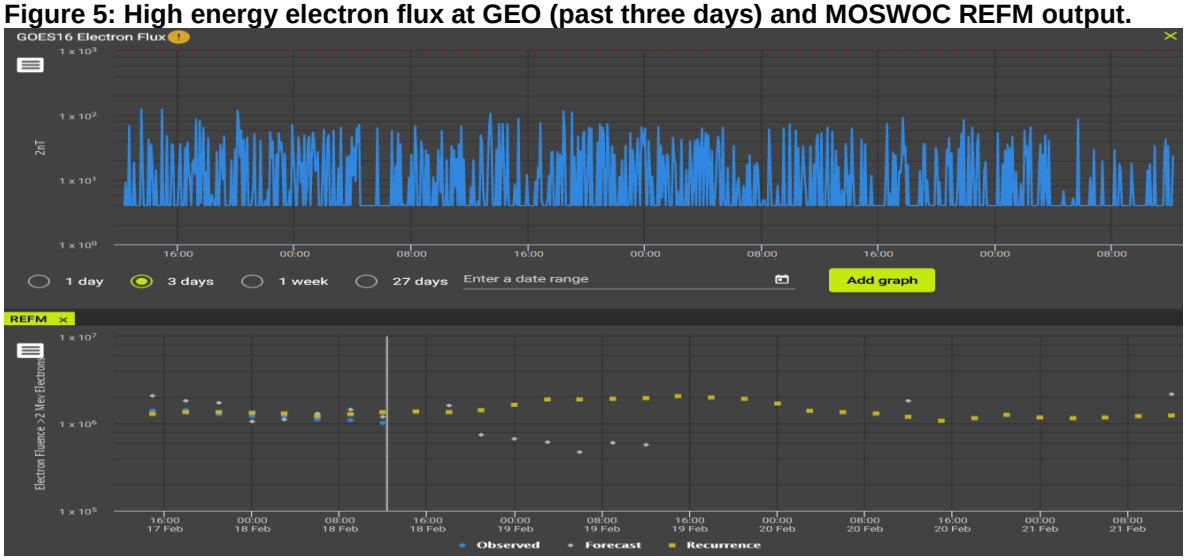

## High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) at GOES16 is expected to remain at background levels. There are no significant coronal hole fast wind enhancements expected, and any potential CME glancing blow on day 3 most likely to be weak. These are not expected to drive a significant significant increases in electron flux.

24-hour fluence values are expected to continue well below the Active (1e8 integrated pfu) threshold, as suggested by REFM which is considered to be providing good guidance.

| GEO Electron Environment | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1x10^8$ | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ 2 MeV ≥ $1x10^9$ | No | 1 | 1 | 1 | 1 |

**Figure 5: High energy electron flux at GEO (past three days) and MOSWOC REFM output.**

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